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# SCIENTIFIC INFORMATION REPORT

Physics and Mathematics

(24)

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SCIENTIFIC INFORMATION REPORTPhysics and Mathematics (24)

This is a serialized report consisting of unevaluated information prepared as abstracts, summaries, and translations from recent publications of the Sino-Soviet Bloc countries. It is issued in six series. Of these, four, Biology and Medicine, Electronics and Engineering, Chemistry and Metallurgy, Physics and Mathematics, are issued monthly. The fifth series Chinese Science, is issued twice monthly, and the sixth series, Organization and Administration of Soviet Science, is issued every 6 weeks. Individual items are unclassified unless otherwise indicated.

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## I. PHYSICS

Atomic and Nuclear Physics1. Collective Compound Nuclei Excitation

"Excitation of Collective Compound Nuclei During Scattering of Fast Particles," by V. I. Belyak; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, Vol 26, No 9, Sep 62, pp 1180-1189

The scattering of fast particles on collective compound nuclei excited by the interaction of the incident particle with the nuclear surface has been examined in a number of works. In this connection various assumptions on the type of collective nuclear movement have been used.

In this article, a number of relations are obtained between the scattering cross sections and the nuclear parameters (the derived probabilities of the electrical transitions, the quadrupole moment) which are not dependent on the type of collective nuclear movement for some general assumption concerning the interaction of particles with the nuclear surface. The applicability of these relations is demonstrated for the diffraction as well as the Bohr approximation during scattering at small angles.

2. Gamma Radiation Spectra and Inner Conversion Electrons In Gd Isotopes

"Spectra of Gamma Radiation and Inner Conversion Electrons Arising in the Reaction ( $n, \gamma$ ) in Gadolinium Isotopes," by L. V. Groshev et al.; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, Vol 26, No 9, Sep 62, pp 1119-1133

In agreement with contemporary representation, the majority of low levels, lying in the energy gap limits ( $2\Delta$ ) of even-even nuclei with  $A > 100$ , have a collective of biparticle nature. Recently many attempts have been made to explain theoretically the nature of these levels. In connection with this it is of interest to obtain as much experimental data as possible on low levels of even-even nuclei. Some information may be obtained by investigating the radiation emitted during the capture of thermal neutrons by nuclei.

Gamma radiation spectra and inner conversion electrons emitted during the capture of thermal neutrons by  $Gd^{155}$  and  $Gd^{157}$  isotopes are investigated in this article.

3. Microscopic Description of Nonspherical Nuclei Collective Levels

"Microscopic Description of Collective Levels of Nonspherical Nuclei," by D. F. Zaretskiy and M. G. Urin, Moscow Engineering Physical Institute; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3(9), Sep 62, pp 1021-1030

The collective excitation in nonspherical nuclei is investigated by the method of approximate second quantization. The problem of excluding nonspherical states is examined. Corrections to the equation defining the energy and to the electromagnetic transition probabilities in the case of  $\beta$  excitation are determined. The calculations are carried out by taking into account the interaction between neutrons and protons.

4. Annihilation of Positrons in an Ionized Gas

"Annihilation of Positrons in an Ionized Gas," by I. N. Toptygin, Leningrad Polytechnical Institute; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3(9), Sep 62, pp 1031-1036

The lifetime of positrons in ionized hydrogen and the shape of the annihilation line are calculated. It is shown that the Coulomb correlations play an important role in the broad temperature range.

5. Threshold Singularities in Pion-Nucleon Scattering

"Near Threshold Singularities in Exchange Pion-Nucleon Scattering," by L. I. Lapidus, Joint Institute for Nuclear Research; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3(9), Sep 62, pp 1053-1056

Possible nonmonotonous variation with energy of the differential cross section for forward exchange scattering of pions by nucleons due to the existence of new particles is investigated by the dispersion relation method. The magnitude and energy width of the near-threshold nonmonotonies are estimated.



6. Amplitude Vertex Parts in Direct Nuclear Processes

"Vertex Parts of the Amplitudes for Direct Nuclear Processes," by I. S. Shapiro, Institute of Theoretical and Experimental Physics, Academy of Sciences USSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3(9), Sep 62, pp 1068-1082

The vertex parts previously introduced (I. S. Shapiro, ZhETF, Vol 41, 1961, p 1616; Nucl. Phys., Vol 28, 1961, p 244) are studied on the basis of the optical model. The analytical properties of the vertex part as a function of the transferred momentum are investigated. It is shown that even in the case of a potential well with a diffuse edge an essential singular point at infinity corresponds to the nuclear radius. The effect of diffusion of the nuclear edge on the angular distribution in direct reactions is clarified. The problem of estimating the reduced vertex parts by taking into account dissipation of single particle states is examined.

7. Fission of  $U^{238}$  Nuclei

"Fission of  $U^{238}$  Nuclei by Continuous Spectrum Photons With  $E_{\gamma} \text{ max} = 35$  Mev and by 1/4-Mev Neutrons," by A. P. Komar, B. A. Bochagov, and V. I. Fadeyev, Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSR, Vol 146, No 5, Oct 62, pp 1051-1053

Recently the role of collective moments in the fission of hard, prolate nuclei has been much discussed. In connection with this there was interest in comparing the energy and the mass distribution of heavy nuclei fragments split by photons and neutrons for various angular intervals.

A two-pulsed ionization chamber with grids which operate by collecting electrons was used in the investigations. The target of fissionable matter, transparent for fission fragments, was placed on the common cathode of the chamber. The beam of the fission agents was directed perpendicular to the surface of the target and, consequently, to the surface of the cathode. The electron pulses of the chamber are used to obtain information not only of the energy of paired fragments but also on the angle between the direction of the fragment emissions and the beam.

8. Proton-Proton Scattering

"Proton-Proton Scattering at High Energies," by S. A. Azimov, G. G. Arushnov, and A. A. Yuldashev, Physico-technical Institute, Academy of Sciences Uzbek SSR; Tashkent, Izvestiya Akademii Nauk UzSSR, Seriya Fiziko-Matematicheskikh Nauk, No 2, 1962, pp 76-81

A phenomenological optical model of nuclear interactions is widely used in analyzing the experimental data of  $\pi$ -p and p-p scattering at high energies (S. Fernbach, R. Serber, and I. B. Taylor, Phys. Rev., 1949, p 1352). In order to explain the experimental results of elastic proton-proton scattering at energies of 3 and 8.5 Bev it must be admitted that the magnitude of the real and the imaginary parts of the elastic scattering amplitude are of the same order. However the experiment does not show Coulomb interference and nuclear scattering.

In this article it is shown that on the basis of the general quantum mechanical theory of scattering of identical particles that the experimental data on p-p scattering at energies of 3 and 8.5 Bev may be satisfactorily explained with the hypothesis of a purely imaginary elastic p-p scattering amplitude.

9. Polish Nuclear Physics Institutes

"Development of Atomic Physics in Poland"; Tudomany es Technika, Bratislava, No 20, 9 Oct 62, p 697

Nuclear research institutes were developed further in Poland in 1962. The largest atomic center, in Swierk near Warsaw, was expanded with two large laboratories and a reactor manufacturing plant. The isotope laboratory of the institute was completed this year also. The Swierk installations now being built will make possible investigation of the properties of matter at temperatures near absolute zero. Construction of the second Polish reactor will be completed this year, and there will be further progress in the area of plasma physics research. They have also prescribed a significant increase in the manufacture of isotope measuring instruments.

Solid State Physics10. Spin-Lattice Relaxation in Paramagnetics

"Theory of Spin-Lattice Relaxation in Paramagnetics With Strong Exchange Interaction," by A. K. Morocha, Kazan' Affiliate, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2297-2305

The spin-lattice relaxation in paramagnetics with strong exchange interactions is investigated theoretically. General expressions for time relaxation are obtained. It is shown that relaxation goes through an "exchange" system. A comparison with experiment is made for the crystal free radical  $\alpha$ -diphenal- $\beta$ -picryl hydrazyl.

11. Thermal Conductivity of NiZn Ferromagnetic Semiconductors

"Thermal Conductivity of Ni-Zn Ferromagnetic Semiconductors in the 80-500°K Temperature Range," by I. K. Kamilov, Moscow State University imeni M. V. Lomonosov; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2312-2318

Results of measurements of the thermal conductivity of nickel-zinc ferrites  $Ni_{1-x}Zn_xFe_2O_4$  are examined where x varies from 0 to 1.

The nature of the temperature range for the thermal conductivity of the above ferrites is considered. The effect of the magnetic transformation on thermal conductivity is given. On the basis of the experimental results an hypothesis on the effect of the ferromagnetic impurity centers on the temperature relation for the thermal conductivity of nickel zinc ferrites is advanced.

12. Photoelectric Properties of GaAs p-n Transitions

"Photoelectric Properties of GaAs p-n Transitions," by A. G. Gutkin et al. Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2338-2348

The method of preparing Ga-As photoelements is described briefly. The spectral characteristics of the photoelements, the volt-ampere characteristics of p-n transitions in the photoelement modes and the diode at various temperatures are given and analyzed as well as the temperature dependence for the short-circuit photocurrent and the photo electromotive force at various light intensities, the relaxation characteristic of p-n transitions in the photoelement mode and the photodiode at various intensities and temperatures.

13. Effect of Layer With High Recombination in p-n Transition

"Effect of Layer with High Recombination on Light and Dark Characteristic of the p-n Transition" by V. K. Subashiyev, Institute of Semiconductors, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2359-2364

Expressions are derived for the collection function  $a_p$  of holes from the n-region of a p-n transition for cases where in the n-region all parameters, except the diffusion line for holes (L), remain constant but the change in L is represented by a step-curve with one or two steps. On the basis of the expression obtained for  $a_p$  an analysis is given of the effect of a layer of high recombination on the dark and light characteristic of the p-n transition. It is shown that a layer of high recombination may cause the appearance of anomalously large saturation flows in p-n transition.

14. Photomagnetic Effect Theory in p-n Transitions

"Theory of Photomagnetic Effect in p-n Transitions," by Yu. I. Ravich, Institute of Semiconductors, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2411-2415

The odd photomagnetic effect in p-n transitions is calculated. The magnetic field is weak.

15. Cross-Relaxation Theory in Paramagnetic Crystals

"Theory of Cross-Relaxation in Paramagnetic Crystals," by V. S. Tumanov, Moscow State University imeni M. V. Lomonosov; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2419-2425

General formulas for the first and the second moments of a curved first order cross-relaxation transition are obtained. The formulas are applicable to systems in which the projection of the spin may not be an integral of motion but the concentration of the paramagnetic particles is arbitrary. As examples, the cross-relaxation in two-particle system with spin of  $1/2$  and the cross-relaxation in a ruby are examined.

16. Scattering Cross Sections and Effective Charges of Ions in Metals

"Scattering Cross Sections and Effective Charges of Ions in Metals," by P. P. Kuz'menko, Kiev State University imeni T. G. Shevchenko; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2434-2440

The scattering cross section and the effective charges of ion impurities in copper, silver, gold, aluminum and lead were determined by residual electrical resistivity specified by impurities and thermal vacancies. The scattering cross section of Mott (N. Mott and H. Jones, The Theory of the Properties of Metals. a. Alloys, Oxford, 1936) was used in determining the effective charges. The physical substance of the effective charges is analyzed. It is shown that with the diffusion of multivalent impurities in Cu, Ag, and Au only one of the impurity valent electrons take part in the conductivity and the others are in the bound state.

A computation is also given for the effective charges of atoms in single-component metals based on their temperature electrical resistivity.

17. Ultrasonic Absorption in Piezoelectric Semiconductors

"Ultrasonic Absorption in Piezoelectric Semiconductors," by V. L. Gurevich and V. D. Kagan, Institute of Semiconductors, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2441-2446

The effect of electron conduction on the propagation and absorption of sound in piezoelectric semiconductors when the free flow line of electrons is much larger than the sound wave line is investigated theoretically. The electron-electron interaction (which is small) is taken into account. The expressions obtained are suitable for arbitrary statistics on current carriers.

18. Hot Electron Theory in Semiconductors

"Theory of Hot Electrons in Semiconductors," by Sh. M. Kogan, Institute of Radio Engineering Electronics, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2474-2484

An expression for the power transmitted by lattice electrons at the time of their scattering on an piezoelectric potential of acoustical phonons is obtained when using semiconductors with a sufficiently large concentration of electrons (when the electron temperature representation is justified). It is shown that in a number of cases the scattering energy time and the quadratic deviations from Ohms law have an "anomalous" temperature dependence; they increase with temperature (including at the time of scattering on the deformation potential). During piezoelectric scattering of energy and momentum scattering on a charge impurity in a nonsingular gas the volt-ampere characteristic may have an S-shape. An expression is obtained for the power returned by the lattice electrons in a magnetic field in the ultraquantum case. The effect of negative differential conductivity, obtained by R. F. Kazarinov and V. G. Skobov (AhETF, Vol 42, No 4, 1962, p 1047) for the crossed distribution of electric and magnetic fields takes place in the longitudinal case not only during deformation scattering but also during scattering on the piezoelectric potential of the acoustic phonons.

19. Some Features of Electron-Nuclear Resonance

"Some Features of Electron-Nuclear Resonance of Local Electron Centers Near the Surface of a Nonmetallic Crystal," by M. D. Glinchuk and M. F. Deygen, Institute of Semiconductors, Academy of Sciences Ukrainian SSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2521-2529

The frequency spectrum of the electron-nuclear resonance for local electron centers near the surface of a crystal is obtained. The dependence of the frequency on the crystal orientation in an external static magnetic field for NaCl and a diamond lattices is determined. Spectrum features and angular dependences of resonance frequencies in comparison with corresponding volumetric values may be used as a method to distinguish surface states from volumetric states.

20. Electrons and Holes Scattering

"Electron and Hole Scattering Doped InSb, InAs and GaAs," by I. M. Tsidil'kovskiy, Institute of Physics of Metals, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2539-2549

The role of various mechanisms for the scattering of current carriers in a semiconductor during a rise in their concentration is examined qualitatively. The nonparabolic nature of the conductivity band is calculated at large electron concentrations in InSb, InAs and GaAs. An analysis of the experimental data shows that the electrons in these junctions are scattered at high temperatures mainly by optical lattice oscillations and the holes by acoustical lattice oscillations.

21. Theory of Secondary Electron Emission

"Theory of Secondary Electron Emission," by S. V. Izmaylov, Leningrad State Pedagogical Institute imeni A. I. Gertsen; Leningrad, Fizika Tverdogo Tela, Vol 4, No 9, Sep 62, pp 2554-2566

The relations of the number  $\eta$  of inelastically reflected electrons on the energy  $\mathcal{E}_p$  of primary electrons with normal incidence of the latter on a target is examined and the distribution of inelastically reflected electrons on energy  $\mathcal{E}$  is determined. Furthermore an analysis of the effect of inelastically reflected primary electrons on the coefficient  $\delta$  of emission of slow secondary electrons is given. It is shown that the nature of the relations  $\eta = \eta(\mathcal{E}_p)$  and  $\delta = \delta(\mathcal{E}_p)$  depends substantially on the indexes of energy in the laws for energy loss ( $s$ ) and reflection ( $r$ ) of primary electrons.

22. Kinetics of Formation of ZnS Film

"Study of Kinetics of Formation of Film of ZnS in the Process of Reactive Diffusion of Sulphur in Zinc," by N. N. Sirota and N. N. Koren', Division of Solid State Physics and Semiconductors, Academy of Sciences Belorussian SSR; Minsk, Doklady Akademii Nauk BSSR, Vol 6, No 10, Oct 62, pp 626-628

The study of kinetics of formation of zinc sulfide semiconductor films on the surface of zinc monocrystals is of considerable interest for finding the reactive diffusion mechanism of sulfur in zinc which accompanies the formation of a junction at a fusion temperature considerably higher than the reacting components and also for various practical points of view.

This article studies the rate of formation of zinc sulfide films on various faces of a zinc monocrystal when interacting with sulfur vapors subject to time and temperature. In addition, the kinetics of formation of a zinc sulfide film on the surface of a liquid metal is investigated.

### 23. Electron Energy Spectrum Theory of Metals

"Theory of Electron Energy Spectrum of Metals With a Bismuth Type Lattice," by A. A. Abrikosov and L. A. Fal'kovskiy, Institute of Physical Problems, Academy of Sciences USSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3(9), Sep 62, pp 1089-1101

The electron energy spectrum of metals of the fifth group of the periodic system is determined on the basis of some quantitative assumptions and of the symmetry theory.

### 24. Green's Function for Electrons in a Metal

"Green's Function for Electrons in a Metal and Analysis of the Electron Spectrum," by A. A. Abrikosov, Institute of Physical Problems, Academy of Sciences USSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3(9), Sep 62, pp 1083-1088

Properties of Green's function for electrons in a metal are investigated. The problem of determining the shape of this function near its pole and of locating the electron spectrum is solved. The results obtained are similar to those obtained in the model of non-interacting particles in a periodic field.

### 25. Diffusion in Entry of Substances Into Discharge Cloud

"The Role of Diffusion in the Processes of Penetration of Substance Into Discharge Cloud," by Yu. P. Pollyul', Leningrad, Optika i Spektroskopiya, Vol 13, No 2, Aug 62, pp 270-272

Examined is the influence of "third" elements on the entry processes of material of metallic electrodes into the discharge cloud.

The causes by which the influence of "third" elements are explained may be divided into four groups: the influence is determined by the variation of evaporation processes, by chemical reactions on the surface of electrodes, by charges in structure of specimens, and by the dilution factor.



The analysis was carried out on alloys with a constant atomic ratio of iron and the "third" element (1:1), also iron and small additions of other elements (Si, Mn, Cr, Ni at 4%).

## 26. Appearance of Current Instability in Semiconductors

"Appearance of Current Instability in Semiconductors," by L. E. Gurevich and I. V. Ioffe, Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2641-2646

A theory of instability is developed for a constant current in semiconductors with intrinsic conductivity located in electric and magnetic fields. Two cases are examined: (1) when there is no illumination and the magnetic field is not parallel to the electrical field; (2) when both fields are parallel and the illumination creates additional carriers. In both cases criteria for the rise in instability and for the frequencies of the rising oscillations are obtained.

## 27. Theory of Heavily Doped Semiconductors

"Theory of Heavily Doped Semiconductors," by V. L. Bonch-Bruyevich, Moscow State University imeni M. V. Lomonosov; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2660-2674

The problem of the density of states, the Fermi level and the radius of shielding in a heavily doped semiconductor is examined. Explicit formulas are obtained for the asymptotic case  $na_0^3 \gg 1$ , where  $n$  is the impurity concentration and  $a_0$  the Bohr radius of the crystal. The Coulomb interaction between the electrons is taken into account. It is shown that in principle the density of states is other than zero everywhere in the "forbidden zone," but quickly decreases as it moves away from the bottom of the zone of conductivity (or hole zone if the problem concerns holes in the presence of acceptors). Close to the Fermi level the density of the states is similar to that of an ideal Fermi gas. The Fermi level  $\mu$  for an absolute zero temperature is somewhat lower than that of an ideal gas of the same density, where the Coulomb interaction and not the presence of "tails" plays the main role in the density of states. The magnitude of the relative shift is on the order of  $(na_0^3)^{-1/3}$ .

28. Thermomagnetic Effects in Semiconductors

"Thermomagnetic Effects in Semiconductors With Degenerate Bands," by E. Normantas and G. Ye. Pikus, Institute of Semiconductors, Academy of Sciences USSR, Institute of Physics and Mathematics, Academy of Sciences Lithuanian SSR,; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2692-2707

The thermomagnetic coefficients of p-germanium semiconductors are computed using the theory developed earlier by G. L. Bir and G. Ye. Pikus for the scattering of current carriers in semiconductors with degenerate bands.

29. Spin Structure of Hole Levels and Saturation of Cyclotron Resonance

"Spin Structure of Hole Levels in Degenerate Band and Saturation of Cyclotron Resonance," by G. R. Khutsishvili, Institute of Physics, Academy of Sciences Georgian SSR; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2708-2713

The problem of the saturation of cyclotron resonance in the degenerate valent zone of germanium is examined. It is shown that with the cyclotron transition there occurs a change in the projection of the hole spin in the direction of the external magnetic field. The effect of the saturation of cyclotron resonance on nuclear resonance is examined.

30. Induced Conductivity in Germanium

"Induced Conductivity in Germanium Bombarded by Potassium Ions," by I. A. Abroyan, Polytechnical Institute imeni M. I. Kalinin; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2719-2726

Results are given of the investigation of additional conductivity arising in germanium during the bombardment of its surface by a pulsed beam of potassium ions. The energy of the bombarding particles was changed from 100 to 10,000 ev. The possible causes for the change of conductivity in germanium under ion bombardment are discussed. On the basis of experimental data an estimate of the number of charged electrons in the conductivity band is given as well as the probability of their yield in a vacuum.

31. Backing Material on Secondary Electron Emission

"Influence of Backing Material on Secondary Electron Emission of MgO Film," by V. L. Borisov, Leningrad Polytechnical Institute imeni M. I. Kalinin; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2738-2740

It is shown that a marked influence on the magnitude of the coefficient of secondary electron emission of MgO films (100-750 Å) is exerted by the backing material.

When using tungsten as backing the magnitude  $J_{\text{max}}$  exceeds by roughly 50 percent  $J_{\text{max}}$  for MgO film on graphite, moreover this ratio increases with an increase in  $V_p$ . An explanation of the results obtained is given on the basis of the work of L. N. Dobretsov and T. L. Matskevich (ZhTF, Vol 27, 1957, p 734).

32. Spin Lattice Relaxation

"Spin Lattice Relaxation in  $K_3(\text{Co}, \text{Fe})(\text{CN})_6$ ," by I. V. Ovchinnikov, Institute of Organic Chemistry; Leningrad, Fizika Tverdogo Tela, Vol 4, No 10, Oct 62, pp 2750-2754

The theory of spin lattice relaxation in potassium ferrocyanide is examined. Relaxation parameters are computed by the method of strong crystal field. The lack of agreement between the theoretical and the experimental result is explained either by the unsuitability of the method of strong crystal field to calculating the relaxation in compounds with a pronounced covalent character of the bond or that the group  $\text{Fe}(\text{CN})_6^{3-}$  forms a stable, isolated complex, weakly connected with the rest of the lattice.

Field Theory33. Electromagnetic Field Excited by Electric Dipole in Tapered Region

"An Electromagnetic Field Excited by an Electric Dipole in a Tapered Region" (presented by Academician V. A. Fok 17 April 1962), by G. D. Malyuzhinets and A. A. Tuzhilin, Acoustical Institute, USSR Academy of Sciences; Moscow, Doklady Akademii Nauk SSR, Vol 146, No 5, 11 Oct 62, pp 1039-1042

The solution S of the scalar problem of diffraction of a spherical wave in space is given by the expression

$$S(\rho, \varphi, z, \rho_0, \varphi_0, z_0) = \frac{1}{2\pi i} \int_{-\infty}^{\infty} \frac{e^{iK R(\varphi - \alpha)}}{R(\varphi - \alpha)} S(\alpha) d\alpha$$

In his doctor's thesis (Nekotoryye Obobshcheniya Metoda Otrazheniy v Teorii Difraktsii [Some Generalizations of the Method of Reflection in the Theory of Diffraction], Izdatel'stvo AN SSR, 1950) Malyuzhinets gives a method for the solution of the functional equation for the function  $s(\lambda)$ , such that the integral in the above equation satisfies the conditions of any diffraction problem whose solution is given by the equation.

This paper presents a generalization of this method for the case of vector functions  $S$  and  $s$ . For simplification, the problem is formulated in terms of a Hertz vector.

### 34. Quantum Mechanics Expression for Current Density of Energy

"Quantum Mechanics Expression for Current Density of Energy," by B. M. Askerov; Baku, Izvestiya Akademii Nauk Azerbaydzhanskoy SSR; Seriya Fiziko -- Matematicheskikh i Technicheskikh Nauk, 1962, No 3, pp 77-80

The article is concerned with finding expressions in quantum mechanics for the current density of energy. Particles in scalar potential fields and electrons in arbitrary electromagnetic fields are studied.

### 35. Normal Skin Effect in a Magnetic Field

"Quantum Theory of a Normal Skin Effect in a Magnetic Field at Low Temperatures," by V. V. Andreyev and A. M. Kosevich, Physico-technical Institute, Academy of Sciences Ukrainian SSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3 (9), Sep 62, pp 1060-1067

A quantum kinetic equation is derived for an electron gas in a strong constant magnetic field and for a weak variable electric field under normal skin effect conditions. Only elastic scattering of electrons on impurities is taken into account. The kinetic equation can be set up and solved in the case of a quadratic isotropic dispersion law and of low concentration of short range impurities without the assumption of smallness of the interaction potential between the electron and the impurity. In the case of an arbitrary dispersion law and scattering potential the quantum kinetic equation is solved by the perturbation theory. Quantum oscillations of the conductivity tensor are examined.

36. Semiclosed Worlds in General Theory of Relativity

"Semiclosed Worlds in the General Theory of Relativity," by Ya. B. Zel'dovich, Institute of Theoretical and Experimental Physics, Academy of Sciences USSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3 (9), Sep 62, pp 1037-1043

Solutions of general relativistic equations are examined for which the region of constant density is surrounded by empty space. A class of solutions is found in which the approach from an infinite point in a vacuum leads to a singularity on the gravitational radius but beyond this singularity the metric behaves in a peculiar way - the radius begins to increase again and vanishes only after passing through a maximum. The properties of these solutions are discussed.

37. Wave Function of e-H Collision

"On the Wave Function of the e-H Collision," by R. K. Peterkop; Leningrad, Optika i Spektroskopiya, Vol 13, No 2, Aug 62, pp 153-158

The author shows that in the case of short range forces for any energy of a system  $E$ , the symmetric expansion of the wave function in terms of atomic functions may be transformed into a form in which the contribution to effective cross section is made only by members corresponding to excitation of the atom up to energy  $\leq 1/2E$ , and at  $E < 0$  up to energy  $\leq E$ . The functions of the scattered electron are not singular under this condition. The conversion to Coulomb interaction was examined. The phase of the integral for the scattering amplitude may logarithmically differ. Obtained are converging integral expressions for the scattering amplitudes.

38. Motion of Bodies of Variable Mass

"On the Theory of the Motion of Bodies of Variable Mass in the Relativistic Variation," by A. A. Mindin; Kiev, Prykladna Mekhanika, Vol 8, No 5, pp 546-551

A differential equation was obtained for the motion of a body, the traction of which is formed by emission of photons and the expulsion of mass particles. The problem is solved in the relativistic variation, i. e. under the assumption of velocities approaching that of light. The solution of the resulting equation gives the law of expenditure of mass for moving bodies of combined action, similar to the corresponding law of Tsiolkovskiy.

Mechanics39. Shape and Load Factors on Metal Fatigue

"The Influence of the Factors of Shape and Type of Load on the Fatigue of Metals," by O. M. Romaniv, I. P. Vyval', and Corresponding Member of Academy of Sciences, Ukrainian SSR, G. V. Karpenko; Kiev, Dopovidi Akademii Nauk Ukrain's'koi RSR, No 8, 1962, pp 1017-1019

Comparative data for circular specimens machined from some steels and aluminum alloys tested for fatigue during plane and torsional bending is presented. The experiment makes it possible to check the efficiency of some size effect hypothesis and hysteresis hypothesis of shape effect (M. Kawamoto and K. Nishikova, Mem. Fac. Eng. Kyoto Univ., 17, 1, 1955). The fatigue limits obtained for plane bending were substantially higher than those for torsional. Since identical conditions were obtained in respect to energetical, gradiential and technological factors, the conclusion is drawn that the dominating influence on this effect is one arising from the Weibull-Afanas'yev statistical hypothesis. Attention is drawn to the discrepancy of fatigue data on serial torsion machines and the fatigue limits of various machine parts obtained during plane bending.

40. Critical Forces on a Strip with a Crack

"Solution of the Problem of Determining the Critical Forces for a Strip With an Off-Center Crack," by V. V. Pansyuk and B. L. Lozovoy (Presented by G. N. Savin, Member of Academy of Sciences, Ukrainian SSR); Kiev, Dopovidi Akademii Nauk Ukrain's'koi RSR, No 8, 1962, pp 1032-1036

The author gives a solution of the problem of stressed-strained state of an elastic strip with a crack for the case when the crack is placed unsymmetrically with respect to the axis of the strip, but its direction perpendicular to its lateral surface. The case when the edges of the crack do not contact during the process of deformation of the strip is considered. Determined are values of the critical forces reached when the strip breaks down.

41. Asymptotic Theory of Elastic Shells

"An Asymptotic Theory of the Statics and Dynamics of Elastic, Circular Cylindrical Shells," by U. K. Nigul; Prikladnaya Matematika i Mekhanika, Vol 26, No 5, Sep Oct 62, pp 923-930

The article presents a linear theory of the statics and dynamics of circular cylindrical shells, as an asymptotic approximation to a 3-dimensional theory of elasticity for  $a \rightarrow 0$  ( $a$  = thickness of shell). Consequently, it is possible to determine sufficiently slowly varying conditions of tension ( $a^2 p^2 \ll 1$ ) with an asymptotic error of order  $\theta_0 \sim a^2 p^2 + a^4$ . For brevity this is called an asymptotic theory in the article. ( $p$  = index of variability.)

The asymptotic theory presented is an extension of results obtained earlier by the author (Tr. Tallinskogo Politekh. In-ta, 1960, No 176), using the basic method of a power series and derived from the two-dimensional shell theory of N. A. Kil'chevskiy (PMM, 1939, Vol II, No 4), and V. V. Novozhilov and R. M. Finkel'shteyn (PMM, 1943, Vol 7, No 5).

In contrast to the foregoing works, all of the quantities in the article are expressed by means of a decision function. The suggested theory does not depend on specific properties of power series, and it makes possible the analysis of various hypotheses and evaluation of the accuracy of different variants in the Kirchhoff theory.

At the end of the article are given the results of the analysis of the accuracy of Novozhilov's theory in the statistical computation of circular cylindrical shells in trigonometric series. A class of problems is presented for which the asymptotic error in Novozhilov's theory does not exceed the limit of  $a$  or  $a^{1/2}$ .

42. Axisymmetrical Deformation of Shells

"Axisymmetrical Deformation of Sloping Orthotropic Shells of Revolution," by A. N. Guz', (presented by G. N. Savin, Academician Ukrainian SSR); Kiev, Dopovidi Akademii Nauk Ukrain's'koi RSR, No 8, 1962, pp 1044-1047

The axisymmetrical deformation of sloping orthotropic shells of revolution, circular in plan, is considered in this paper. The method of expansion by a small parameter is used for the solution.

The problem is reduced to finding special solutions of the equation, if we have the solution of the corresponding problem for an isotropic shell. The first approximation is found for the case of a spherical shell. A numerical example shows the great effect of an increase in  $E_0$  on the strained state of the shell.

#### 43. Elastic Anisotropic Half-Plane

"A Mixed Problem for an Elastic Anisotropic Half Plane," by V. A. Sveklo; Moscow, Prikladnaya Matematika i Mekhanika, Vol 26, No 5, Sep/Oct 62, pp 896-906

A regular solution, i.e., continuous to the second derivative, is sought for the equations of motion

$$\begin{aligned} a \frac{\partial^2 u}{\partial x^2} + d \frac{\partial^2 u}{\partial y^2} + c \frac{\partial^2 v}{\partial x \partial y} + X &= \rho \frac{\partial^2 u}{\partial t^2} \\ c \frac{\partial^2 u}{\partial x \partial y} + d \frac{\partial^2 v}{\partial y^2} + a \frac{\partial^2 v}{\partial x^2} + Y &= \rho \frac{\partial^2 v}{\partial t^2} \end{aligned}$$

at the points of the anisotropic half plane  $y \geq 0$  for initial conditions  $u(x, y, 0) = u_0(x, y)$ ,  $v(x, y, 0) = v_0(x, y)$ ,  $(\partial u / \partial t)_0 = u_0'(x, y)$ ,  $(\partial v / \partial t)_0 = v_0'(x, y)$ ; and boundary conditions  $\tau_{xy}(x, 0, t) = A(x, t)$ ,  $\partial v(x, 0, t) = B(x, t)$ .

The given functions are on the right side of these equations. Equations of Green and Volterra apply in the general case.

Submitted 8 December 1961.

#### 44. Solution of Spatial Problems in Theory of Elasticity

"A Method Solution of Some Spatial Problems of the Theory of Elasticity," by B. L. Abramyan (presented by Academician N. Kh. Arutyunyan, Armenian SSR, Academy of Sciences, 11 Apr 62); Yerevan, Doklady, Akademiya Nauk Armyanskoy SSR, Vol 35, No 4, 1962, pp 151-159

Functions of P. F. Papkovich are used to find solutions to some spatial problems of the theory of elasticity. Under consideration is the case when the body of rotation is deformed symmetrically with respect to the plane of one of its axial cross sections.



45. Theorem on Theory of Plastic Medium

"On the Proof of Theorems of the Flow Theory for Work Hardening Materials," by R. A. Vasin; Vestnik Moskovskogo Universiteta, Seriya I, Matematika, Mekhanika, No 5, Sep-Oct 62, pp 60-64

The author gives a condition for the function of hardening  $h$  of zero order with respect to stress rates. This condition is sufficient for the fundamental theorems of the flow theory to be valid for work hardening materials.

46. Auto-Oscillation and Stability of an Elastic System

"Self-Oscillation Conditions in an Elastic Controlled System," by V. B. Larin; Kiev, Prykladna Mekhanika, Vol 8, No 5, pp 482-488

The problems of the stability and self-oscillation of an elastic mechanical system with a hydromotor, similar to the executive mechanism of an airplane automatic pilot are investigated.

The motion of the system is described by a system of nonlinear differential equations of the third order, investigated by the small parameter method.

First approximation formulas are obtained for the amplitude and frequency of the auto-oscillations. The conditions for the stability of the system are presented.

47. Plastic Deformations

"Equilibrium of Flexible Elastic-Plastic Shells and Plates," by N. F. Yershov; Kiev, Prykladna Mekhanika, Vol 8, No 5, pp 489-498

During deformation of plates and shells, plastic deformations may appear in the material after loss of stability.

The theory of small elastic-plastic deformations was applied to find the basic elastic-plastic dependences for shells of positive or gaussian curvature.

The post-critical elastic-plastic work of plates having Euler stresses less than the yield point was investigated. With the appearance of plastic deformations in the plate two regions are formed: an elastic region, described by Carman equations and an elastic-plastic described by Lepik's equations.

An approximate method was worked out for integrating the indicated system of equations for plates with free resting of the rims along the entire contour, compressed in one direction. Plastic deformations were found to have, a considerable effect on the postcritical work of relatively rigid plates.

### Aerodynamics

#### 48. Temperature Distribution in a Free Molecular Flow

"Temperature Gradients during a Free Molecular Expansion in Vacuum," by A. S. Pleshanov (presented by A. A. Dorodnitsyn, 18 Apr 62); Moscow, Doklady Akademii Nauk SSSR, Vol 146, No 4, 1962 pp 782-784

The fulfillment of the inequality  $l \ll \gamma$  is a necessary condition for free molecular flow of gas in space of a particular size  $l$ , with a minimum length of mean free path  $\gamma$ . The simplest form of such a flow, when collisions between the molecules are completely absent, is examined. The initial distribution of particle velocities at each point of the initial volume, generally speaking, may be arbitrary.

### Gas Dynamics

#### 49. Rarefied Fermi Gas Properties

"Properties of a Rarefied Fermi gas With Attraction," by S. V. Maleyev, Leningrad Physicotechnical Institute, Academy of Sciences USSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 43, No 3 (9), Sep 62, pp 1044-1052

A rarefied Fermi gas with attraction which is in the ground state is examined. By summation of perturbation theory diagrams equations are derived for the particle proper energy operator and for the energy of effective interaction between the particles. These equations are solved without expanding the powers of the interaction. The complete expression for the effective interaction energy contains a term which corresponds to the presence of a Bose-condensate of bound Cooper

pairs. The presence of this term makes it possible to obtain in the expression for the proper energy the pole term which is responsible for the appearance of a gap in the single fermion excitation spectrum. A possibility of experimental detection of a Bose-condensate of Cooper pairs in super conductors is indicated.

#### 50. Molecular Flux at Low Pressures

"Theory of Molecular Flux at Low Pressures. I. Flow of Rarefied Gases through Pipes with Diaphragms," by V. I. Lozgachev; Leningrad, Zhurnal Tekhnicheskoy Fiziki, Vol 32, No 8, Aug 62, pp 1023-1031

Examined is the flow of rarefied gases through a system of pipes and openings in the condition when the mean free path of the molecules is greater than the dimensions of the container. With usual simplifying assumptions, the relation between the incident density of the molecules along the walls and the probability of their passage through a given container in a straightforward and back directions was found. Compact formulas for probabilities in relation to geometric parameters of a given system were obtained.

#### Hydrodynamics

#### 51. Surfaces of Discontinuities With Release of Energy in Magnetic Hydrodynamics

"Study of a Surface of Discontinuity with Release (Absorption) of Energy in Magnetic Hydrodynamics," by A. A. Barmin; Moscow, Prikladnaya Matematika i Mekhanika, Vol 26, No 5, Sep/Oct 62, pp 801-810

The article is concerned with surfaces of discontinuities on which occur exothermic or endothermic reactions in a conducting medium with infinite conductivity in the presence of an arbitrary magnetic field.

A quantitative study of discontinuities with exothermic reactions in a conducting medium when the flow is perpendicular and the magnetic field is parallel to the surface of discontinuity was made by Cross, Chinitz, and Rivlin (JAS, 1960, Vol 27, No 24). The author notes that this case can be extended to gas dynamics, but with a different dependence of the internal energy of the density.

V. P. Demutskiy and R. V. Polovin (ZhTF, Vol 31, No 4, 1961) studied discontinuities with endothermic and exothermic reactions for any orientation of the field and flow, but for the case in which the amount of energy released and the square of the velocity of the Alfen wave is much less than the square of the speed of sound.

In this paper the author studies discontinuities with release (absorption) of energy without limitation of the magnitude and direction of the flow and voltage of the magnetic field and amount of released energy. It is indicated that in the general case there are possible two types of detonations and two types of impact ionization, in which the reaction zone results from either a fast or slow shock wave. In addition, four forms of discontinuities of a type of burning are possible. Two of them are discontinuities of contraction and two are discontinuities of rarefaction. The character of the change of jumps in density, pressure, magnetic field, velocity of the gas, temperature, and entropy due to discontinuity dependent on intensity of the discontinuity and released energy has been studied.

Limitations on the magnitudes of the field and released energy are determined for which slow detonation does not take place; and two forms of burning are found whose rate approaches the speed of Alfen waves. Part of the results of this work has been published in a previous paper by the author (DAN SSSR, Vol 138 No 1, 1961).

Optics and Spectroscopy52. Calculation of Luminescence of a Cylinder

"Calculation of Luminescence of a Cylinder With Negative Absorption Coefficient in the Approximation on Geometric Optics," by A. M. Samson and Yu. I. Chekalinskaya, Institute of Physics, Academy of Science Belorussian SSR; Minsk, Doklady Akademii Nauk SSSR, Vol 6, No 10, Oct 62, pp 633-637

The volumes of an active medium of cylindrical form are used often in quantum generators and amplifiers. A rigorous calculation of the light field inside and outside the cylinder is, however, a difficult problem. In this article expressions for the light field on the axis of a right circular cylinder are obtained by the geometrical optics method and a number of conclusions are made on the effect of the parameters of the cylinder on the characteristics of luminescence.

53. Absorption Bands in Condensed Oxygen

"Shape of the Absorption Bands in Condensed Oxygen (6300-4773 Å)," by V. I. Dianov-Klovov; Leningrad, Optika i Spektroskopiya, Vol 13, No 2, Aug 62, pp 200-205

The dependence of the shape of absorption bands of 6290, 5769 and 4773 Å for condensed oxygen on the temperature ( $T=78-300^\circ\text{K}$ ;  $p=0.31, 0.76, \text{ and } 1.2\text{ g/cm}^3$ ; pressure up to 250, 950, and 3,500 atm., respectively) and density ( $T=78^\circ\text{K}$ ;  $p=1.2-1.9\text{ g/cm}^3$ ; pressure up to 7,000 atm.) was examined. The observed side views are satisfactorily described by an expression with one arbitrary constant.

The dependence of the intensity of band  $\epsilon = f(p)$  in compressed liquid and  $\gamma$ -oxygen (up to the transition  $\gamma \rightarrow \beta$ ) at  $78^\circ\text{K}$  was refined.

54. Infrared Absorption Spectrum of Silicon

"Infrared Absorption Spectrum of Silicon Irradiated by Fast Neutrons," by E. N. Lotkova, V. S. Vavilov and N. N. Sobolev; Leningrad, Optika i Spektroskopiya, Vol 13, No 2, Aug 62, pp 216-221

The spectrum of infrared absorption in the region of 1-14 microns for P and N silicon treated with 1-2 Mev neutrons is investigated. The investigation was made at 290, 78 and 18° K. After irradiation in spectra of N-type silicon, bands of 1.8, 3.5, 3.7 and 5.5 microns were discovered; in P-type, bands of 1.8, 3.5, 3.7, and 5.9 microns. The formation of absorption bands due to the treatment is explained by the appearance of local levels in the forbidden zone.

55. Occurrence of Brewster and Superposition Bands

"On the Occurrence of Brewster and Superposition Bands," by N. A. Vlasenco, V. K. Miloslavskiy, and I. N. Shklyarevskiy; Leningrad, Optika i Spektroskopiya, Vol 13, No 2, Aug 62, pp 250-255

Conditions of occurrence of Brewster bands in white light and superposition bands in monochromatic light for the general case, taking into account the multiple reflections inside each of the plates, are examined. An essential difference between Brewster bands and superposition bands is shown. The condition of continuity of a chromatic Brewster band, connecting the thickness of the plate and the width of spectral interval of the light is derived. Analysis of Brewster bands occurring during the combination of dual-beam interferometer with a plane-parallel silver-plated plate is given.

56. Theory of Imperfect Circular Polariscopes

"On the Theory of the Imperfect Circular Polariscopes," by Kh. K. Aben; Leningrad, Optika i Spektroskopiya, Vol 13, No 2, Aug 62 pp 256-258

An analysis was made of the accuracy of the imperfect circular polariscopes in which the auxiliary double refracting plates are parallel. It turned out that in this case the isochromatic lines in the balance polariscopes are distorted, but they may not be distorted in an unbalanced polariscopes. The conducted analysis makes it possible to determine which polariscopes gives greater accuracy with given auxiliary double refracting plates.

Electricity57. Short-Circuit Current of Electrostatic Generator

"Measurement of Short-Circuit Current of a Rotary Electrostatic Generator With a Dielectric Belt Operating in Various Pure Gases and Their Mixtures," by N. J. Felici and A. F. Kalganov; Leningrad, Zhurnal Tekhnicheskoy Fiziki, Vol 32, Vol 32, No 8, Aug 62, pp 1001-1011

Results are given of the measurement of short-circuit current of a rotary electrostatic generator with a dielectric belt in some pure gases and their mixtures (hydrogen, nitrogen, carbon dioxide, and others) which depend on voltage excitation, pressure, and composition of the gas mixture. A considerable increase of current is observed in certain mixtures of nitrogen and hydrogen. A favorable factor for the increase of current and decrease of the voltage excitation necessary for normal operations of the generator proved to be the possible use of rubbing ionizers from a thin metal grid.

58. Measuring Resistance in Bridge Circuit of Ratiometer

"Design of a Bridge Circuit of a Ratiometer, Both Loops of Which Are Connected to the Measuring Diagonal," by V. P. Vlasov; Moscow, Priborostroyeniye, No 10, Oct 62, pp 1-2

A symmetrical bridge circuit of a ratiometer, both loops of which are connected to the measuring diagonal, is widely used in industry; for example, in measuring temperature with a thermistor.

In the design of a suitable ratiometer there often arises the problem of changing the scaling of the circuit on the basis of an existing measuring mechanism which is related to changes in the range of measurement; i.e., the necessity for varying the circuit of a sensor. The article concerns the derivation of a formula which makes it possible to measure, with a simple final adjustment, the resistance in the circuit of a ratiometer for any type of design. The current in the loops is given as a function of the change in resistance in the arms.

Sound59. Energy of Sound Waves in Moving Media

"Energy of Sound Waves Propagated in Moving Media," by O. S. Ryzhov and G. M. Shefter; Moscow, Prikladnaya Matematika i Mekhanika, Vol 26, No 5, Sep/Oct 62, pp 854-866

This paper is a development of a previous work by Ryzhov concerning an equation derived from the law of the conservation of energy as applied to propagation of sound waves in arbitrary nonhomogeneous moving media (PMM, Vol 26, No 2, 1962). On the basis of this equation a further study is made on the assumption that the width of the region of agitated motion of the gas is small compared with the radius of curvature of the shock front and with the distance through which the parameters of the original medium actually vary. It is possible to simplify significantly the equation indicated above and, by integrating it, to obtain a formula defining the variation of excess pressure on the front of the shock wave in the proximity of geometrical acoustics ("Geometrical Acoustics: I. The Theory of Weak Shock Waves," by J. B. Keller, J. Appl. Phys., Vol 25, No 8, 1954; et al). Additional damping of the amplitude of the wave, by comparison with the acoustics, is explained by the dissipation of energy originating with the shock transference.

The author also discusses applying the propagation of waves of small amplitude in arbitrary media to the solution of a system of two ordinary differential equations for the length of the sound wave and the excess pressure on the wave front.

Miscellaneous60. New Siberian Training Facility

"A Physicomathematical School", Moscow, Vechernyaya Moskva, 2 Nov 62

A reprinted item from Vechernyy Novosibirsk states that a Physicomathematical School will be established under the Siberian Department of the Academy of Sciences USSR and the university. The facility will help to accelerate training of young specialists in mathematics, physics, modern engineering, and natural science -- both theoreticians and experimenters. The school will continue the business of the all-Siberian olympiad and the summer physicomathematical school. It will operate as a boarding school and will start functioning in January 1963. Along with 86 participants selected during the third round of the olympiad, 40 young boys and girls will be accepted in the facility.



## II. MATHEMATICS

61. Solution of a Riemann Linear Boundary Value Problem for Two Functions

"Solution of a Riemann Linear Boundary Value Problem for Two Functions and Its Application to Several Mixed Problems in the Planar Theory of Elasticity," by G. P. Cherepanov; Moscow, Prikladnaya Matematika i Mekhanika, Vol 26, No 5, Sep/Oct 62, pp 907-912

In the general case, the Riemann boundary value problem for many functions reduces to a system of Fredholm equations. A more thorough study of this problem is found in the article of F. D. Gakhov (Usp. Matem. N., 1952, Vol 7 No 4, pp 3-54) and in the monograph of N. I. Muskhelishvili (Singulyarnyye Integral'nyye Uravneniya [Singular Integral Equations], Moscow-Leningrad, Gostekhizdat, 1946). In another article by Gakhov ("Riemann Boundary Value Problem for a system of n Pairs of Functions," DAN SSSR, 1949, Vol 67 No 4) is given an effective closed solution for the case in which the matrix coefficient of the Riemann problem is the product of two matrices whose elements are analytic in the corresponding interior and exterior regions of the boundary L, excluding a certain number of points which may contain poles. In the article first cited is also given then the closed solution for the case of the coefficient of the Riemann problem, appearing as a functionally commutative matrix. In an article by G. N. Chebotarev, several other cases of the Riemann problem for many functions are considered, being solved in closed form. (Uch. Zap. Kazansk. Un-ta, 1956, Vol 116, No 4, pp 31-58).

62. Dynamic Programming for Nonlinear Systems

"Reduction of Several Problems in Dynamic Programming for Nonlinear Systems to Transcendental Equations," by Ya. N. Roytenberg; Moscow, Prikladnaya Matematika i Mekhanika, Vol 26, No 5, Sep/Oct 62, pp 950-952.

In a previous paper (PMM, 1962, Vol 26, No 3), the author considered the problem of dynamic programming connected with the realization of a selected means of controlling an action, i.e., the problem of the choice of the controlling media whose use would be in accordance with the law of motion, in phase space (or subspace), of the nonlinear controlled system.

The determination of the controlling media in the problem considered requires first of all the solution of a system of nonlinear integral equations (obtained in the paper cited above) of the following form:

$$z_j(t) = \Gamma_j(t) - \sum_{k=1}^r x_{jk}(t) \int_{t_0}^{t_1} \Phi_{jk}(t, \tau) \psi_k(z_1(\tau), \dots, z_r(\tau), \tau) d\tau + \sum_{k=1}^r \int_{t_0}^t W_{jk}(t, \tau) \psi_k(z_1(\tau), \dots, z_r(\tau), \tau) d\tau \quad (t_0 \geq t \geq t_1) \quad (j = 1, \dots, r).$$

Generally speaking, the solution of these equations requires numerical methods. In connection with this, the transformation from the nonlinear integral equation indicated above to a system of finite transcendental equations approximating the required  $z(t)$  by step functions is shown.

### 63. Approximate Solution of Fredholm Equation

"Approximate Solution of a Fredholm Integral Equation With Two Variables," by D. G. Grebenyuk, Institute of Mathematics imeni V. I. Romanovskiy, Academy of Sciences Uzbek SSR; Tashkent, Izvestiya Akademii Nauk Uzbekskaya SSR: Seriya Fiziko-Matematicheskikh Nauk, No 4, 1962, pp 12-16

The article concerns a Fredholm integral equation with two variables. Using the method of L. G. Shnirel'man (Izv. AN SSSR: Seriya Matem. Nauk, No 1, 1938), the author searches for a generalized polynomial as the best approximation to the solution. Two examples are given.

Submitted on 30 December 1960.

### 64. Nonlinear Singular Integral Equations

"A Theory of Nonlinear Singular Integral Equations," by F. S. Khadzhimullayev, Tashkent State University imeni V. I. Lenin; Tashkent, Izvestiya Akademii Nauk Uzbekskaya SSR: Seriya Fiziko-Matematicheskikh Nauk, No 4, 1962, pp 22-32

The equation  $u(x) = f(x) + \lambda \int_a^b \frac{K(x, t)}{t - x} h[t, u(t)] dt$ , where  $f(x)$  is continuous in  $a \leq x \leq b$ ;  $K(x, t)$  in  $a \leq x, t \leq b$  and  $h(t, y)$  in  $[a, t \leq b, c \leq y \leq d]$  satisfy the Lipschitz condition with respect to their variables;  $\lambda, a$ , and  $b$  are real numbers; and the integral, insofar as it is singular, is regarded in the sense of Cauchy's principle value.

Conditions for the existence of solutions to this equation are determined.

65. Approximating Functions by Linear Integral Operators

"The Order of Approximation of Functions by a Family of Linear Integral Operators," by A. S. Dzhaferov; Baku, Izvestiya Akademii Nauk Azerbaydzhanskoy SSR; Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk, No 3, 1962, pp 3-16

By means of a family of linear integral operators, the author derives an integral normalized approximation for polynomial functions and proves several theorems relative thereto. An equation which tends to zero is obtained for a class of linear operators. Saint Venant's principle is applied to the resulting harmonic and bounded functions satisfying the initial conditions.

66. Approximate Asymptotic Solutions of Functions by Means of Linear Operators

"The Approximate Asymptotic Solution of Functions by Means of a Family of Linear Operators," by A. D. Gadzhiev, A. S. Dzhaferov, and L. G. Labaker; Baku, Izvestiya Akademii Nauk Azerbaydzhanskoy SSR; Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk, No 3, 1962, pp 19-27

The author obtains an approximate asymptotic solution of functions by means of a family of linear integral operators of the type

$$L\lambda(f, x) = \int_{-\infty}^{\infty} \left[ \sum_{k=1}^{\infty} p_{k,\lambda} f(x + \alpha_{k,\lambda} t) \right] K_{\lambda}(t) dt,$$

where  $\lambda \ll 0$  is a parameter and  $p_{k,\lambda}, \alpha_{k,\lambda}$  ( $\alpha_{k,\lambda} \geq 0$ ;  $k = 1, 2, \dots$ ) are real numbers.

Of several theorems for operators which are proven, the article is concerned mainly with the following one:

If: (1) A measurable function  $f(x)$  in the neighborhood of a point  $x_0$  has derivatives to the  $(n-1)^{th}$  order inclusive and at point  $x_0$  has right and left finite  $n^{th}$  derivatives  $f^{+(n)}(x_0)$  and  $f^{-(n)}(x_0)$ ; furthermore, if  $|f(x)| \ll \phi(x)$ ,  $-\infty < x < \infty$ , where  $1 \ll \phi(x) < \infty$ ; and if:

(2) For any  $\sigma > 0$  when  $\lambda \rightarrow \infty$

$$\int_{-\infty}^{\infty} \mu(\alpha t) \phi(t) K_{\lambda}(t) dt = o(\Delta_{\lambda}),$$

where  $\mu(t) = \sup_{\substack{-\infty < x < \infty \\ |y| \leq t}} \frac{\phi(x+y)}{\phi(x)} < \infty,$

then 
$$\lim_{\lambda \rightarrow +\infty} \frac{L \lambda (f, x_0) - f(x_0)}{\lambda \cdot \Delta_\lambda} = \frac{f^{(n)}(x_0) \pm f^{(n)}(x_0)}{n!}$$
 where the sign on the right side is  $+$  or  $-$  depending on whether  $n$  is even or odd.

Several types of operators are studied, and the conditions for the validity of the theorem are determined.

#### 67. Approximation of Differentiable Functions by Linear Operators

"Asymptotic Approximation of Multiply-Differentiable Functions by Positive Linear Operators" (presented by Academician V. I. Smirnov, 3 May 1962), by R. G. Mamedov, Institute of Mathematics and Mechanics, Academy of Sciences Azerbaydzhan SSR; Moscow, Doklady Akademii Nauk SSSR, Vol 146, No 5, 11 Oct 62, pp 1013-1016

Much time has been devoted to the study of asymptotic approximations of differentiable functions by linear polynomial operators; however, the existence of a rule for the general case has not been fully formulated. In this article, the author establishes the asymptotic dependence of the approximation of a function by any positive linear operator on various-order derivatives of the approximated function.

#### 68. Integrals on Semiadditive Measures and Application to Theory of Integral Functions

"An Integral on a Semiadditive Measure and Its Application to the Theory of Integral Functions: Part I," by A. A. Gol'dberg; Moscow, Matematicheskii Sbornik: Novaya Seriya, Vol 58, No 3, Nov 62, pp 289-334

In the paper, indicators are evaluated for integral functions of a nonintegral order, with limitations imposed on the upper angular densities of their zeros. The first significant results along this line were obtained by B. Ya. Levin (Raspredeleniye Korney Tselykh Funktsiy / "Distribution of Roots of Integral Functions", Gostekhizdat, Moscow, 1956), some of whose ideas are presented here.

The paper is in two parts: (1) "An Integral on a Semiadditive Measure" and (2) "Evaluations for Indicators of Integral Functions of a Nonintegral Order."

Part (1) includes a definition of an integral for the general case and several theorems for integrals of non-negative bounded functions and integrability of functions. In addition, there are several auxiliary theorems relating to the foregoing.

Part (2) consists for the most part of proofs of the most important theorems of Part (1).

Submitted on 5 June 1961.

#### 69. Partial Sums of Fourier Series

"Indetermination Limits of Subsequences of Partial Sums of a Fourier Series," by D. Ye. Men'shov; Moscow, Matematicheskii Sbornik: Novaya Seriya, Vol 58, No 3, Nov 62, pp 335-376

The upper and lower limits of a sequence of partial sums of a trigonometric series  $T = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx)$ , i.e., the quantities  $\overline{\lim}_{n \rightarrow \infty} S_n(x)$  and  $\underline{\lim}_{n \rightarrow \infty} S_n(x)$ , where

$$S_n(x) = \frac{a_0}{2} + \sum_{k=1}^n (a_k \cos kx + b_k \sin kx) \quad (n = 1, 2, \dots),$$

are called the upper and lower limits of the series.

Several theorems are proven establishing the relation between a Fourier series and its partial sum.

Submitted on 23 June 1961.

70. Stability of Trivial Solution of Differential Equation

"The Problem of Stability of a Trivial Solution of an N-th Order Differential Equation," by B. N. Skachkov; Leningrad, Vestnik Leningradskogo Universiteta; Seriya Matematiki, Mekhaniki i Astronomii, No 19, Issue 4, 1962, pp 56-61

Two theorems are given concerning the stability of the trivial solution of the differential equation.

$$x^{(n)} + p_1(t)x^{(n-1)} + \dots + p_{n-1}(t)x' + p_n(t)x = 0,$$

where  $p_1(t) \dots p_n(t)$  are continuous real functions of  $t$  satisfying, for certain constants  $\ell_i^-$  and  $\ell_i^+$  the conditions  $\ell_i^-(t) < \ell_i^+(t)$  ( $i = 1, 2, \dots, n$ ).

In the first it is shown that if  $n$  conjugate complex numbers can be chosen which satisfy certain inequalities, then the trivial solution of the equation is stable. The second theorem is a consequence of the first, and in it it is shown that if the roots of an  $n$ -th degree polynomial in  $x$  satisfy certain other inequalities, then the trivial solution of the equation is stable.

The given equation has previously been studied by V. M. Starzhinskiy for the cases in which  $n = 2, 3, 4$ , and  $p_1, p_2, p_3$  are constants (PMM, XVI, Issue 3, 1952; PMM, XVI, Issue 4, 1952; and PMM, XIX, Issue 4, 1955).

Submitted on 29 November 1961.

71. Second-Order Parabolic Equations With Discontinuous Coefficients

"A Theory of Second-Order Parabolic Equations With Discontinuous Coefficients," by G. K. Namazov; Baku, Izvestiya Akademii Nauk Azerbaydzhanskoy SSR; Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk, No 3, 1962, pp 37-49

A solution of the first boundary value problem is obtained for a second-order parabolic equation with discontinuous coefficients which is continuous together with its first derivatives, at all points of a region bounded by a cylinder. The methods of O. A. Oleynik (DAN SSSR, 1959, No 6, p 124; and Izv. AN SSSR, Seriya Matem., 1961, 25, pp 3-20) are applied.

This problem was studied by I. V. Girsanov for the case in which the coefficients of the equation and surface of discontinuity do not depend on time (DAN SSSR, 1960, No 6, p 135).

72. Sufficient Conditions for Continuous Dependence

"Some Sufficient Conditions for the Continuous Dependence of a Solution of a Differential Equation on the Parameter," by N. N. Petrov; Leningrad, Vestnik Leningradskogo Universiteta: Seriya Matematiki, Mekhaniki Astronomii, No 19, Issue 4, 1962, pp 26-40

The paper contains some results on the continuous dependence of the solution of the equation  $dx/dt = X(t, x, \lambda)$  on the parameter  $\lambda$ .  $X$  and  $x$  are  $m$ -dimensional vectors. In some cases, the theorems obtained are better than those of Krasnosel'skiy, Kreyn, Kurzweil, and Vorel.

Such a case exists, for instance, in the equation

$$\frac{dx}{dx} = x_k k^{1-\alpha} \cos \beta kt + k^{1-\beta} \sin kt, \quad x_k(0) = 0, \\ k \rightarrow \infty \text{ for } \alpha > 0, \beta > 0, \alpha + \beta > 1.$$

The example is considered in detail.

Submitted on 14 November 1961.

73. Lower Bound of Approximation of Continuous Functions

"The Lower Bound of Approximation of Continuous Functions by Positive Linear Operators," by N. A. Sapogov; Leningrad, Vestnik Leningradskogo Universiteta: Seriya Matematiki, Mekhaniki i Astronomii, No 19, Issue 4, 1962, pp 49-55

The paper contains some results on the approximation to continuous functions by positive linear operators. Particular cases of these results are theorems on the approximation to continuous functions by positive linear polynomial operators (algebraic or trigonometric) which have been proven by P. P. Korovkin ("The Order of Approximation of Functions by Positive Linear Operators," DAN, 114, 1957; and Lineynyye Operatory i Teoriya Priblizheniy [Linear Operators and the Theory of Approximation], Moscow, Fizmatgiz, 1959).

74. Normalization of Boolean Algebra

"Normalization of Boolean Algebra" (presented by Academician V. I. Smirnov, 18 December 1961), by D. A. Vladimirov, Leningrad State University imeni A. A. Zhdanov; Moscow, Doklady Akademii Nauk SSSR, Vol 146, No 5, 11 Oct 62, pp 987-990

The author defines such concepts as the "difference" of elements  $x$  and  $y$  of an algebra  $X$ , a "measure" on and "automorphism" of an algebra, a "normalized" and a "fully homogeneous" algebra, and the "component or principal ideal" of an algebra. Five theorems are presented pertaining to these concepts.

Conditions are established for which a Boolean algebra is normalized, i.e., it possesses a positive, real, countably additive measure. If the elements of the algebra are interpreted as events, then it becomes a question of adding to these events probabilities with common properties.

75. Recursive Abelian Groups

"Recursive Abelian Groups," by Academician A. I. Mal'tsev; Moscow, Doklady Akademii Nauk SSSR, Vol 146, No 5, 11 Oct 62, pp 1009-1012

The discussion is based on four theorems:

1. "The periodic part of a constructive group is recursively enumerable. There exist constructive Abelian groups whose periodic part is not recursive.

2. "All primary components of a constructive periodic group  $G$  are recursive; the set  $\Pi(G)$  is recursively enumerable. For each recursively enumerable set  $\Pi$  of prime numbers there exists a periodic Abelian constructive group  $G$  for which  $\Pi = \Pi(G)$ .

3. "In order that a torsion-free constructive Abelian group of even rank have an algorithm of linear dependence, it is necessary and sufficient that it have a recursively enumerable basis. A constructive numeration  $\alpha$  of a group  $R \infty$  is the auto-equivalent of a constructive numeration  $\beta$  of group  $R \infty$  having a recursively enumerable basis if and only if  $\alpha$  also has a recursively enumerable basis. There exist constructive numerations of  $R \infty$  for which there does not exist a recursively enumerable basis in  $R \infty$ .



4. "A subgroup  $G$  is recursive if and only if its characteristic appears in the form  $\chi(i) = \mu x(f[i, x] = 0)$ , where  $f[i, x]$  is a proper general recursive function. A subgroup  $G$  is recursively enumerable if and only if its characteristic appears in the form  $\chi(i) = \mu x(f[i, x] \text{ - indeterminate})$ , where  $f[i, x]$  is a proper partially recursive function. The totality of regular points of a recursive subgroup is a recursively enumerable set. Each recursively enumerable set of natural numbers is the totality of regular points of a proper recursive subgroup."

76. Differential Equations in Linear Topological Spaces

"Theory of Differential Equations With Derivatives Having a Small Coefficient in Linear Topological Spaces" (presented by Academician I. G. Petrovskiy, 12 May 1962), by V. M. Millionshchikov; Moscow, Doklady Akademii Nauk SSSR, Vol 146, No 5, 11 Oct 62, pp 1021-1024

The theory of differential equations with derivatives having small coefficients has been developed by A. N. Tikhonov and I. S. Gradshteyn (Matem. Sborn., 27 (69), No 1, 1950; DAN, 65, No 6, 1949; and others).

In this paper, the theory is generalized for the case of arbitrary linear topological spaces. Several definitions necessary in the discussion are given: "uniformly asymptotic stability" of a given set of equations, "a set with an isolated point," and "closure of a set."

## III. CONFERENCES

77. Recent Soviet Conferences in Physics

The conferences listed below were reported or announced in recent issues of Soviet periodicals. Included in the listing are the date and location of the conference, sponsoring organizations, and source. Unless otherwise noted, it is assumed that there was no non-Soviet participation in the conferences.

a. Tenth All-Union Conference on Cathode Electronics; 23-30 November 1961, Tashkent. (Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, No 11, Nov 62, entire issue)

b. Ninth Annual Conference on the Physics of Low Temperatures; 26 June-1 July 1962, Leningrad; representatives from Hungary, the GDR, and Czechoslovakia. (Vestnik Akademii Nauk SSSR, No 10, Oct 62, p 109)

c. Fifth All-Union Conference on the Theory of Semiconductors; 29 October-3 November 1962, Baku; sponsored by the Academy of Sciences USSR, the Academy of Sciences Azerbaydzhan SSR, and the Azerbaydzhan State University imeni S. M. Kirov. (Bakinskiy Rabochiy, 4 Nov 62, p 3)

d. Expanded Conference of the All-Union Seminar on Radioisotope Measuring Technique; 1-21 October 1962 1962, Tbilisi; sponsored by the Academy of Sciences USSR, the Academy of Sciences Georgian SSR, the State Committee of the Council of Ministers USSR on the Use of Atomic Energy, and the State Committee of the Council of Ministers Georgian SSR for Coordination of Scientific Research Work. (Zarya Vostoka, 21 Oct 62, p 3)

\* \* \*

Washington, DC 20505

7 September 2004

Ms. Roberta Schoen  
Deputy Director for Operations  
Defense Technical Information Center  
7725 John J. Kingman Road  
Suite 0944  
Ft. Belvoir, VA 22060

Dear Ms. Schoen:


In February of this year, DTIC provided the CIA Declassification Center with a referral list of CIA documents held in the DTIC library. This referral was a follow on to the list of National Intelligence Surveys provided earlier in the year.

We have completed a declassification review of the "Non-NIS" referral list and include the results of that review as Enclosure 1. Of the 220 documents identified in our declassification database, only three are classified. These three are in the Release in Part category and may be released to the public once specified portions of the documents are removed. Sanitization instructions for these documents are included with Enclosure 1.

In addition to the documents addressed in Enclosure 1, 14 other documents were unable to be identified. DTIC then provided the CDC with hard copies of these documents in April 2004 for declassification review. The results of this review are provided as Enclosure 2.

We at CIA greatly appreciate your cooperation in this matter. Should you have any questions concerning this letter and for coordination of any further developments, please contact Donald Black of this office at (703) 613-1415.

Sincerely,



Sergio N. Alcivar  
Chief, CIA Declassification Center,  
Declassification Review and Referral  
Branch

Enclosures:

1. Declassification Review of CIA Documents at DTIC (with sanitization instructions for 3 documents)
2. Declassification Status of CIA Documents (hard copy) Referred by DTIC (with review processing sheets for each document)



## Processing of OGA-Held CIA Documents

The following CIA documents located at DTIC were reviewed by CIA and declassification guidance has been provided.

OGA Doc ID	Job Num	Box	Fldr	Doc	Doc ID	Document Title	Pub Date	Pages	Decision	Proc Date
AD0333357	78-03117A	187	1	24	4083	Scientific Information Report Organization And Administration Of Soviet Science (6)	12/4/1962	94	Approved For Release	3/29/2004
AD03333955	78-03117A	190	1	20	4197	Scientific Information Report Organization And Administration Of Soviet Science (7)	1/15/1963	100	Approved For Release	3/29/2004
AD03343986	78-03117A	194	1	1	4341	Scientific Information Report Organization And Administration Of Soviet Science (8)	3/5/1963	129	Approved For Release	3/29/2004
AD03353307	78-03117A	196	1	2	4421	Scientific Information Report Organization And Administration Of Soviet Science (9)	3/19/1963	85	Approved For Release	3/29/2004
AD03363305	78-03117A	199	1	14	4550	Scientific Information Report Organization And Administration Of Soviet Science (10)	4/24/1963	99	Approved For Release	3/29/2004
AD03373360	78-03117A	203	1	2	4702	Scientific Information Report Organization And Administration Of Soviet Science (11)	6/13/1963	65	Approved For Release	3/29/2004
AD03386886	78-03117A	205	1	41	4816	Scientific Information Report Organization And Administration Of Soviet Science (12)	7/18/1963	67	Approved For Release	3/29/2004
AD0342004	78-03117A	208	1	24	4913	Scientific Information Report Organization And Administration Of Soviet Science (13)	8/21/1963	89	Approved For Release	3/29/2004
AD0343882	78-03117A	211	1	15	5033	Scientific Information Report Organization And Administration Of Soviet Science (14)	9/24/1963	127	Approved For Release	3/29/2004
AD0343989	78-03117A	213	1	12	5111	Scientific Information Report Organization And Administration Of Soviet Science (15)	10/18/1963	58	Approved For Release	3/29/2004
AD0345283	78-03117A	215	1	21	5180	Scientific Information Report Organization And Administration Of Soviet Science (16)	11/18/1963	61	Approved For Release	3/29/2004
AD0344526	78-03117A	217	1	34	5255	Scientific Information Report Organization And Administration Of Soviet Science (17)	12/24/1963	32	Approved For Release	3/29/2004
AD0347731	78-03117A	222	1	6	5419	Scientific Information Report Organization And Administration Of Soviet Science (19)	2/27/1964	53	Approved For Release	3/29/2004
AD0332259	78-03117A	182	1	34	3907	Scientific Information Report Physics And Mathematics (21)	10/8/1962	58	Approved For Release	3/29/2004
AD0332752	78-03117A	184	1	24	3975	Scientific Information Report Physics And Mathematics (22)	11/1/1962	57	Approved For Release	3/29/2004
AD0333426	78-03117A	187	1	31	4090	Scientific Information Report Physics And Mathematics (23)	12/6/1962	38	Approved For Release	3/29/2004
AD0333956	78-03117A	189	1	33	4171	Scientific Information Report Physics And Mathematics (24)	1/8/1963	38	Approved For Release	3/29/2004
AD0334380	78-03117A	192	1	4	4260	Scientific Information Report Physics And Mathematics (25)	1/31/1963	53	Approved For Release	3/29/2004
AD0335121	78-03117A	195	1	3	4384	Scientific Information Report Physics And Mathematics (26)	3/14/1963	71	Approved For Release	3/29/2004